REVISION OF ARENIG BIVALVIA FROM RAMSEY ISLAND, PEMBROKESHIRE

by R. M. CARTER

ABSTRACT. Stratigraphically important Lower Ordovician (Arenig) bivalves from Ramsey Island, Pembrokeshire, are redescribed and illustrated. The two new genera and twelve new species of Hicks (1873) are reduced to the following five species: *Praenucula menapiensis* (Hicks), '*Praearca*' *cambriensis* (Hicks), ? *Cyrtodonta oboloidea* (Hicks), *Glyptarca primaeva* Hicks, and *Actinodonta ramseyensis* (Hicks). The genus *Davidia* is treated as a synonym of *Actinodonta* Phillips 1848.

ALTHOUGH the earliest known bivalve has been described from strata of Middle Cambrian age in Spain (Vogel 1962), it is not until beds of Lower Ordovician age that bivalve faunas with any degree of diversity are found. Our knowledge of most of these faunas is still most inadequately based on their original, generally very old and idealistically illustrated, descriptions. In Europe three localities of Arenig age that are of particular interest are those of Bussaco in Portugal (Ribeiro and Sharpe 1853), where the fauna includes ribeirioids, *Redonia*, several species of '*Ctenodonta*', and small '*Modiolopsis*'; of the Grès Armoricain of Normandy, from which Barrois (1891) described species of '*Ctenodonta*', *Actinodonta*, *Lyrodesma*, and *Redonia* that have recently been re-examined by Babin (1966); and of Ramsey Island, Pembrokeshire, from where Hicks (1873) described twelve species of bivalve that were placed in the genera *Ctenodonta*, *Modiolopsis*, *Palaearca*, *Davidia* (nov.), and *Glyptarca* (nov.). (Two of Hicks's species were originally published in Salter's *Cambridge Catalogue* (1873). One, *Ctenodonta rotunda* Salter, is a *nomen nudum*; the other, *Ctenodonta elongata* Salter, has been referred to the Commission for designation as a *nomen oblitum*.)

It is with the latter, apparently rich, bivalve fauna that this short paper is concerned. Originally I had hoped to re-collect sufficient material to enable a thorough revision of the fauna and modernization of the systematics. Through the kindness of Dr. D. E. B. Bates of Aberystwyth, two days were spent collecting on Ramsey Island from Hicks's original locality in the Ogof Hên Formation (see Bates 1969, for a measured section) at Bay Ogof Hên. This short trip was only sufficient to establish that fossil preservation is generally poor, and hence that considerable time would be needed for the collection of a comprehensive topotypic suite of bivalves.

Examination of the extant type material, variously lodged in the British Museum (Natural History), the Manchester Museum, the Sedgwick Museum, Cambridge, and the Institute of Geological Sciences, London, has established that much of Hicks's original material is unable to be placed in a family, let alone a species, and that most of it should never have been named. However, in view of Hicks's description of two new genera in this fauna, it was felt that even a brief description of the type material, together with re-illustration, would be of some value.

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The fauna is described in systematic order, but to facilitate retrieval of information on any of Hicks's original 'species', a synopsis of results is provided below, based on Hicks's original faunal list.

Hicks 1873		*This paper*
(R) = restrict to type specimen		
Ctenodonta menapiensis Hicks (= *Ctenodonta rotunda* Salter 1873 *nom. nud.*)	=	*Praenucula menapiensis* (Salter)
Ctenodonta cambriensis Hicks (R) (= *Ctenodonta elongata* Salter 1873 *nom. oblit.*)	=	'*Praearca*' *cambriensis* (Hicks)
Palaearca hopkinsoni Hicks (R)	? =	? *Cyrtodonta oboloidea* (Hicks)
Palaearca oboloidea Hicks (R)	? =	*Cyrtodonta oboloidea* (Hicks)
Glyptarca primaeva Hicks	=	*Glyptarca primaeva* (Hicks)
Glyptarca lobleyi Hicks (R)	? =	? *Cyrtodonta oboloidea* (Hicks)
Davidia ornata Hicks (R)	=	*Actinodonta ramseyensis* (Hicks)
Davidia plana Hicks (R)	? =	*Actinodonta ramseyensis* (Hicks)
Modiolopsis ramseyensis Hicks	=	*Actinodonta ramseyensis* (Hicks)
Modiolopsis solvensis Hicks	=	'*Praearca*' *cambriensis* (Hicks)
Modiolopsis cambriensis Hicks	=	*Actinodonta ramseyensis* (Hicks)
Modiolopsis homfrayi Hicks	=	*Actinodonta ramseyensis* (Hicks)

In the descriptions and plate captions, relevant museum collections are referred to as follows: SM—Sedgwick Museum, Cambridge; IGS—Institute of Geological Sciences, London; BM—British Museum (Natural History), London; MM—Manchester University Museum, Manchester. Systematic groupings at the suprageneric level follow Cox and Newell, in Moore (1969).

SYSTEMATIC DESCRIPTIONS

Class BIVALVIA Linné 1758

Subclass PALAEOTAXODONTA Korobkov 1954
Order NUCULOIDEA Morton 1963
Superfamily NUCULACEA Gray 1824
Family PRAENUCULIDEA McAlester 1969

Genus PRAENUCULA Pfab 1934

Type species (*original designation*). *Praenucula dispar expansa* Pfab 1934.

Praenucula menapiensis (Hicks 1873)

Plate 38, figs. 1, 2

1873 *Ctenodonta elongata* Salter (*nom. oblit.*), p. 24 and figure.
1873 *Ctenodonta menapiensis* Hicks 1873, p. 47, pl. 5, figs. 6, 7.
1873 *Ctenodonta rotunda* Hicks; Hicks, p. 47.
1930 *Ctenodonta menapiensis* Hicks; Pringle, p. 12.

Types. The holotype of *elongata* cannot be located in the collections of the Sedgwick Museum.

Lectotype of *menapiensis* (here designated), the specimen figured by Hicks as plate 5, fig. 6, currently held in the Institute of Geological Sciences, London (reg. no. 23234, acc. no. 1/77). One other syntype,

the specimen figured as plate 5, fig. 7, was supposed to have been deposited in Hicks's own collection, part of which is now in the Sedgwick Museum, and part in the Manchester University Museum. This specimen cannot be located.

Précis of original description. Ovate, beaks prominent and pointed, placed nearer to the anterior margin; surface with concentric growth-lines, fimbriated along ventral margins; shell extremities rounded; muscle scars strong; teeth prominent.

Revised description. This description is based on the few available topotypes, together with the lectotype. It is based on the assumption that the species has its umbones nearer the posterior end of the shell.

Shell small (about 5 mm long and 3 mm high), with inconspicuous umbo placed at about posterior quarter. A prominent hinge plate carries the strong chevron taxodont dentition; because of this plate internal moulds carry sharp, conspicuous 'umbones'. Preservation is not good enough to enable any accessory muscle scars to be discerned. The two adductors are both relatively well marked; the anterior is slightly larger, but the posterior is more deeply incised, especially dorsally. Internal valve margins smooth (*not* fimbriated); shell fairly thick. External valve surface with concentric growth-lines only.

The lectotype demonstrates the dentition clearly; there are about seven taxodont teeth, the more posterior being markedly chevron-shaped.

Topotype A44318 (text-fig. 1) shows four chevron teeth posterior to the umbo, two plain lamellar teeth under the umbo, and then an anterior series becoming increasingly chevroned (eleven more altogether). Posteriorly the teeth increase in size, and the ventral part of the chevron becomes the predominant half.

Discussion. Although *elongata* Salter has strict priority over *menapiensis* Hicks, *elongata* has not been used in the literature since its introduction, and has been referred to the Commission for official designation as a *nomen oblitum* under Article 23*b* of the Code.

Of the presently described genera of palaeotaxodontids, *Praenucula* appears to represent the most suitable location for *menapiensis* (see McAlester 1968, pl. 8, figs. 3–9). Further material from Ramsey Island may even result in the merging of *menapiensis* with *Praenucula expansa*, type species of the genus; the two forms appear almost indistinguishable in so far as one can judge from plates alone.

EXPLANATION OF PLATE 38

Figs. 1–17. 1, *Ctenodonta menapiensis* Hicks. Lectotype (IGS 23234), ×6: an internal mould. 2, *C. menapiensis* Hicks, latex rubber cast of lectotype, ×3. 3, Syntype of *C. cambriensis* Hicks (MM 10042), ×3. Probably *Glyptarca*. 4, *C. cambriensis* Hicks, latex rubber cast of syntype (MM 10042). 5, *Ctenodonta cambriensis* Hicks. Latex rubber cast of lectotype, ×3. (Also *Glyptarca primaeva* Hicks in upper right-hand corner.) 6, *C. cambriensis* Hicks. Lectotype (MM 10042), ×3: an internal mould. 7, *Palaearca oboloidea* Hicks, holotype (SM A16743), ×3. 8, *Glyptarca primaeva* Hicks, latex rubber cast of lectotype (SM A16708–11, lectotype arrowed), ×3. 9, 12, *G. primaeva* Hicks, latex rubber cast of respectively the outside and inside of syntype (MM L10043). 10, *G. primaeva* Hicks, syntype (SM A1670–7), ×3. 11, *Glyptarca lobleyi* Hicks, holotype (IGS 24198), ×3. 13, *G. primaeva* Hicks, syntype (MM L10043) (internal moulds only), ×3. 14, *G. primaeva* Hicks, syntype (IGS 24200), ×3. 15, *Modiolopsis solvensis* Hicks, lectotype (IGS 22065), ×3. 16, *Davidia plana* Hicks, holotype (MM L10021), ×3. 17, *M. solvensis*, Hicks, latex rubber cast of lectotype, ×3. See text, p. 251, for revised taxonomy of Hicks' species.

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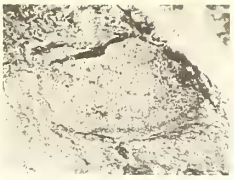

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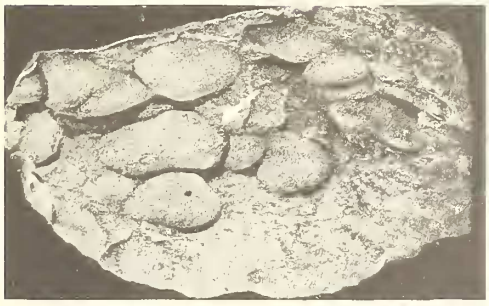

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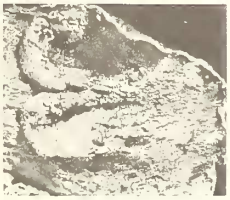

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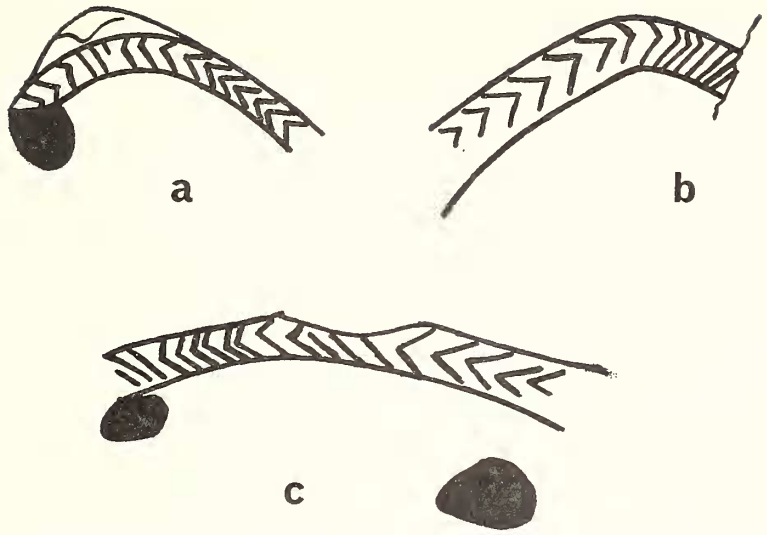

TEXT-FIG. 1. Outline sketches of dentition of topotype *Praenucula menapiensis*; all approx. ×5. (*a*) left valve, SM A44318; (*b*) right valve, SM A44308; (*c*) left valve, SM A44307.

Genus PRAEARCA Neumayr 1891

Type species. Arca? kosoviensis Barrande 1881.

'*Praearca*' *cambriensis* (Hicks 1873)

Plate 38, figs. 3, 4, 5, 6

1873 *Ctenodonta rotunda* Salter (*nom. nud.*), p. 24.
1873 *Ctenodonta cambriensis* Hicks, p. 47, pl. 5, figs. 8, 9.
1873 *Ctenodonta elongata* Hicks; Hicks, p. 47.
1873 *Modiolopsis solvensis* Hicks, p. 50, pl. 5, figs. 18, 19.
1930 *Ctenodonta cambriensis* Hicks; Pringle, p. 12.
1930 *Modiolopsis solvensis* Hicks; Pringle, p. 12.

Types. Lectotype (here designated), the specimen figured by Hicks as plate 5, fig. 9, currently held in the Manchester Museum (reg. no. 10042, attica 8). One other syntype, also held in the Manchester Museum under the same registration number, is extremely badly preserved and almost certainly of a different species.

Précis of original description. Ovate, nearly equilateral with sub-median umbones; regularly convex with strong growth-lines; muscle scars moderately impressed; teeth not as prominent as in *C. menapiensis*.

Revised description (*based on the lectotype*). Shell small (8 mm long and 4 mm high), and of 'symmetrical-nuculanid' shape. Umbones sub-central, not prominent. With narrow hinge plate running the length of the dorsal shell-edge; this plate carries an extremely faint impression of taxodont dentition. Sub-equal adductor muscle scars

can doubtfully be observed beneath the ends of the hinge plate. Ventral shell margins not denticulate.

Modiolopsis solvensis Hicks; Plate 38, figs. 15, 17.

Types. Lectotype (here designated), the specimen figured by Hicks as plate 5, fig. 18, currently held in the Institute of Geological Sciences (cat. no. 22065, accession no. 1/72). The other original syntype, that of plate 5, fig. 19, is missing.

Précis of original description. Rhomboid, small, with a short anterior end and a longer posterior end. With strong anterior and posterior ridges stretching from the umbo to the margins. Hinge-line long and straight, muscle scars large and distinct.

Revised description (*based on the lectotype*). The lectotype is the internal mould of the right valve of a small bivalve (length 10 mm, height 3·5 mm). Umbo is sub-central, distorted so as to look more anteriorly placed. There is a moderately wide hinge plate, but no hinge teeth are preserved. Ventral margins evenly rounded, with a narrow marginal shelf.

Discussion. The name *rotunda* Salter would have priority over *cambriensis* Hicks, but as it was not originally accompanied by either figure or description (i.e. without an indication in terms of the Code, Article 12), *rotunda* may be treated as a *nomen nudum*.

The preservation of the lectotype of *cambriensis* is barely sufficient for familial diagnosis, and placement in *Praearca* is an act of faith rather than of reason. However, the faintly discernible taxodont dentition together with the central umbo and continuously curved hinge plate makes this a 'best guess'. *Ctenodonta*, or a new genus, are two other possible placements, and the possibility also exists that *cambriensis* is a distorted specimen of *Praenucula menapiensis*. Other shells on the same block as the lectotype of *cambriensis* (mainly *Glyptarca*) are uniformly compressed in a direction corresponding to dorso-ventral on the lectotype. It seems unlikely that the posteriorly placed beak of *menapiensis* could have been transformed into the sub-central beak of the lectotype of *cambriensis* by such a stress direction. Also, the lack of markedly impressed muscle scars encourages one to believe that *cambriensis* is distinct from *menapiensis*. (It is, however, probably correct to interpret the type of *Modiolopsis solvensis* Hicks as a distorted specimen of *cambriensis*.)

Thus it appears probable that *cambriensis* is indeed a second species of ctenodontid in the Ramsey Island fauna. There appears to be no similarly symmetrical form in the fauna of the Grès Armoricain (Barrois 1891, Babin 1966); one might hope that '*Leda*' *escosurae* Sharpe of the Bussaco fauna prove to be a senior synonym (this seems unlikely in view of its posterior carina). Otherwise the name *cambriensis* is best confined to the lectotype only, pending the discovery of better-preserved topotypes.

Subclass PTERIOMORPHA Beurlen 1944
Order ARCOIDA Stolickzka 1871
Superfamily CYRTONDONTACEA Ulrich 1894
Family CYRTODONTIDAE Ulrich 1894
? Genus CYRTODONTA Billings 1858

Type species (*subsequent designation*, Williams and Breger 1916). *Cyrtodonta rugosa* Billings 1858.

? *Cyrtodonta oboloidea* (Hicks 1873)

Plate 38, fig. 7

1873 *Palaearca oboloidea* Hicks, p. 48, pl. 5, fig. 10.
?1873 *Palaearca hopkinsoni* Hicks, p. 48, pl. 5, fig. 11.
?1873 *Glyptarca lobleyi* Hicks, p. 48, pl. 5, fig. 5.
1930 *Palaearca oboloidea* Hicks; Pringle, p. 12.
?1930 *Glyptarca lobleyi* Hicks; Pringle, p. 12.
?1930 *Palaearca hopkinsoni* Hicks; Pringle, p. 12.

Types. Holotype, the specimen figured by Hicks as plate 5, fig. 10, currently held in the Sedgwick Museum (A16743).

Précis of original description. Shell almost as long as high, flattened posteriorly, more inflated dorsally. Beak sub-central, nearer anterior end, overhanging cardinal margin; surface with strong growth-lines.

Revised description (*based on holotype*). Shell of pteriiform shape, with straight, long dorsal margin and expanded lobate posterior wing; 9 mm high (measured at right angles to the hinge line), 8 mm wide, moderately inflated. Anterior margin sharply truncated, with umbo situated at the anterior end of the dorsal margin. Though there is clearly a straight dorsal margin, there is no sign of any dentition. The holotype carries a well-marked growth pause at a shell height of about 5 mm.

Palaearca hopkinsoni Hicks

Types. Holotype (the only specimen of this species figured by Hicks, pl. 5, fig. 11) was not located during this study. Hicks attributed it to 'Mr. Hopkinson's collection'. This collection was formerly in the St. Albans City Museum, but was later donated to the Institute of Geological Sciences, London. Neither of these two museums is able to trace this specimen.

Précis of original description. Oval, about $\frac{1}{2}$ in long, and just over half as wide. Beak closer to anterior end; with two muscle-scars.

Glyptarca lobleyi Hicks; Plate 38, fig. 11.

Types. Holotype, the specimen figured by Hicks as plate 5, fig. 5, currently held in the Institute of Geological Sciences (cat. no. 24198, accession no. 1/74).

Précis of original description. Largish shell (about $\frac{1}{2}$ in long, $\frac{3}{8}$ in wide) with a wide posterior end, and a narrow hinge-margin. Inflated, with a prominent beak; with a marked sulcus ventrally.

Revised description (*based on the holotype*). Shell 12 mm high, 10 mm wide; extremely distorted. There is a suggestion of multiple teeth at the anterior end of the hinge line, supporting a tentative guess that the shell is perhaps cyrtodontid; placement as a cyrtodontid is also supported by the markedly overhanging umbo, which suggests a strong hinge plate.

Discussion. The holotype of *oboloidea* (an internal mould and the only specimen that can be referred to the species with certainty) does not appear to be badly distorted, and the shape is certainly characteristic of the cyrtodontids, but in the absence of definitive cyrtodont dentition such judgement must at best be subjective. *Palaearca hopkinsoni* Hicks and *Glyptarca lobleyi* Hicks are themselves so badly preserved that they can only

doubtfully be included in the synonomy of *oboloidea*. Until better preserved material is collected, the names of all three species are best restricted to the types.

Subclass PALAEOHETERODONTA Newell 1965
Order MODIOMORPHOIDA Newell 1969
Superfamily CYCLOCONCHACEA, Ulrich 1884
Family CYCLOCONCHIDAE Ulrich 1884
Genus ACTINODONTA Phillips 1848

Type species (*monotypy*). *Actinodonta cuneata* Phillips.

Actinodonta ramseyensis (Hicks 1873)

Plate 39, fig. 3

1873 *Modiolopsis ramseyensis* Hicks, p. 49, pl. 5, fig. 14.
1873 *Modiolopsis homfrayi* Hicks, p. 49, pl. 5, figs. 16, 17.
1873 *Modiolopsis cambriensis* Hicks, p. 50, pl. 5, fig. 20.
?1873 *Davidia ornata* Hicks; p. 49, pl. 5, fig. 12.
?1873 *Davidia plana* Hicks; p. 49, pl. 5, fig. 13.
1930 *Modiolopsis ramseyensis* Hicks; Pringle, p. 12.
1930 *Modiolopsis homfrayi* Hicks; Pringle, p. 12.
1930 *Modiolopsis cambriensis* Hicks; Pringle, p. 12.
?1930 *Davidia ornata* Hicks; Pringle, p. 12.
?1930 *Davidia plana* Hicks; Pringle, p. 12.

Types. Holotype, the specimen figured by Hicks as plate 5, fig. 14 (this paper, Pl. 39, fig. 3), currently held in the Manchester Museum (L10041). The other figured specimen (pl. 5, fig. 15) was only doubtfully referred to this species by Hicks, and is now missing.

Précis of original description. Ovate, strongly inflated along the dorsal margins. Anterior end short and obtusely rounded; posterior long and pointed. Beak incurved.

Revised description. The holotype is a right valve about 28 mm long, 9 mm high, and with the umbo situated 5 mm from the anterior end. The umbo overhangs the dorsal margins (implying a hinge plate), and there is a long postero-lateral tooth sub-parallel to the shell edge. Posterior end tapering, but broken; anterior end fairly sharply rounded, with a faint trace of an anterior adductor scar. Valve margins smooth.

Davidia ornata Hicks; Plate 39, fig. 5.

Types. Holotype, the specimen figured by Hicks as plate 5, fig. 12 (this paper, Pl. 39, fig. 5), currently held in the Institute of Geological Sciences (cat. no. 24197).

EXPLANATION OF PLATE 39 (*pars*; see also p. 264)

Fig. 1, *Modiolopsis homfrayi* Hicks, latex rubber cast of lectotype (IGS 22063), ×3. 2, *Modiolopsis cambriensis* Hicks, holotype (IGS 22062), ×3. 3, *Modiolopsis ramseyensis* Hicks, holotype (MM L10041), ×3. 4, *M. homfrayi* Hicks, syntype (SM A16750), ×3. 5, *Davidia ornata* Hicks, holotype (IGS 24197), ×3. See text, p. 251, for revised taxonomy of Hicks' species.

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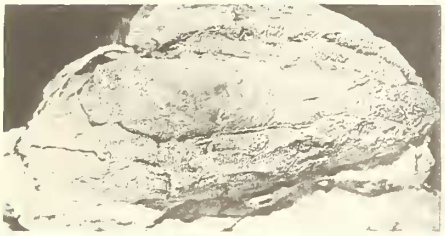

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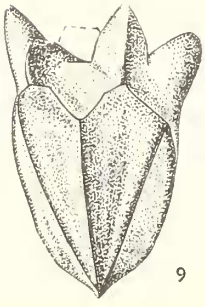

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CARTER, Arenig Bivalvia
GUPTA and WEBSTER, *Stephanocrinus angulatus*

Précis of original description. Ovate, with raised beak and strong anterior and posterior ridges extending from the beak. Surface with strong growth lines; posterior flank with transverse striae converging obliquely from margin to umbo. Hinge-line straight.

Revised description (based on holotype). The holotype is the internal mould of the posterior half of a fairly large ? left valve of a bivalve. Shell lengthened by distortion, umbo missing. Apparently with a long thin postero-lateral tooth parallel to the dorsal borders. The radial striae, if present, are extremely obscure.

Davidia plana Hicks; Plate 38, fig. 16.

Types. Holotype, the specimen figured by Hicks as plate 5, fig. 14 (this paper, Pl. 38, fig. 16), currently held in Manchester Museum (L10021).

Précis of original description. Ovate, with abruptly rounded extremities. Beak incurved, growth-lines not strongly marked.

Revised description (*based on the holotype*). The holotype is a flattened pair of opposing valves of a moderate-sized bivalve (*not* two primarily superimposed left valves as figured by Hicks), the right valve very obscure.

The left valve is about 17 mm long and 8 mm high. Though somewhat distorted, the shell does have a triangular shape due to the sub-central umbones and the angled dorsal margins. There are probably lateral teeth sub-parallel to the shell edge on either side of the umbo.

Modiolopsis hontfrayi Hicks; Plate 39, figs. 1, 4.

Types. Lectotype (here designated), the specimen figured by Hicks as plate 5, fig. 16 (this paper, Pl. 39, fig. 1), currently held in the Institute of Geological Sciences (cat. no. 22063, accession no. 1/71). A further syntype, that of plate 5, fig. 17, is in the Sedgwick Museum (A16750; Pl. 39, fig. 21).

Précis of original description. Ovate, greatly elongated. With a short rounded anterior extremity. There is a moderately strong posterior ridge from the umbo to the margins; hinge-line long and straight.

Revised description (*based on the lectotype*). The lectotype is one of the best-preserved specimens of all Hicks's original syntypes. It is a slightly crushed and perhaps laterally a little attenuated, external mould of the dorsal regions of a fairly large bivalved shell (27 mm long, *c.* 6 mm high, umbo 6 mm from the anterior end). The posterior end is produced into a very sharply rounded extremity; anteriorly the shell is more broadly rounded. Umbones are situated close to the hinge, not prominent. Dorsal margins on either side of the umbones are straight, meeting under the umbones at an angle of *c.* 170°. Teeth not clearly visible. Posterior to the umbones for about 6 mm is a well-defined raised structure on the valve edge that might be either a broken lateral tooth, or a ligament support of some type. It is separated from the main disc of the shell by a marked groove, and carries on its vertical surface a socket for a long thin lateral tooth from the right valve. The structure seems to be broken, and probably extended further posteriorly.

Modiolopsis cambriensis Hicks; Plate 39, fig. 2.

Types. Holotype, the specimen figured by Hicks as plate 5, fig. 20 (this paper, Pl. 39, fig. 2), currently held in the Institute of Geological Sciences (cat. no. 22062, accession no. 1/70).

Précis of original description. Nearly oval, with equally rounded extremities. Beak moderately conspicuous, nearer anterior end, with a ridge running to the posterior end of the shell.

Revised description (*based on the holotype*). Badly preserved steinkern of ? actinodontid type shell, 20 mm long, 7 mm high, with umbones 6 mm from the anterior end. Anterior end broadly rounded; shell tapering posteriorly, with some suggestion of a long postero-lateral tooth.